

orthogonal frequency division multiple access (OFDMA), single carrier-frequency division multiple access (SC-FDMA), and the like. The CDMA may be implemented as a radio technology such as universal terrestrial radio access (UTRA) or CDMA2000. The TDMA may be implemented as a radio technology such as a global system for mobile communications (GSM)/general packet radio service (GPRS)/enhanced data rates for GSM evolution (EDGE). The OFDMA may be implemented by a radio technology such as IEEE (Institute of Electrical and Electronics Engineers) 802.11 (Wi-Fi), IEEE 802.16 (WiMAX), IEEE 802.20, E-UTRA (Evolved UTRA), and the like. IEEE 802.16m, an evolution of IEEE 802.16e, provides backward compatibility with a system based on IEEE 802.16e. The UTRA is part of a universal mobile telecommunications system (UMTS). 3GPP (3rd generation partnership project) LTE (long term evolution) is part of an evolved UMTS (E-UMTS) using the E-UTRA, which employs the OFDMA in downlink and the SC-FDMA in uplink. LTE-A (advanced) is an evolution of 3GPP LTE.

[0031] Hereinafter, for clarification, LTE-A will be largely described, but the technical concept of the present invention is not meant to be limited thereto.

[0032] FIG. 1 shows a wireless communication system.

[0033] The wireless communication system 10 includes at least one base station (BS) 11. Respective BSs 11 provide a communication service to particular geographical areas 15a, 15b, and 15c (which are generally called cells). Each cell may be divided into a plurality of areas (which are called sectors). A user equipment (UE) 12 may be fixed or mobile and may be referred to by other names such as MS (mobile station), MT (mobile terminal), UT (user terminal), SS (subscriber station), wireless device, PDA (personal digital assistant), wireless modem, handheld device. The BS 11 generally refers to a fixed station that communicates with the UE 12 and may be called by other names such as eNB (evolved-NodeB), BTS (base transceiver system), access point (AP), etc.

[0034] In general, a UE belongs to one cell, and the cell to which a UE belongs is called a serving cell. A BS providing a communication service to the serving cell is called a serving BS. The wireless communication system is a cellular system, so a different cell adjacent to the serving cell exists. The different cell adjacent to the serving cell is called a neighbor cell. A BS providing a communication service to the neighbor cell is called a neighbor BS. The serving cell and the neighbor cell are relatively determined based on a UE.

[0035] This technique can be used for downlink or uplink. In general, downlink refers to communication from the BS 11 to the UE 12, and uplink refers to communication from the UE 12 to the BS 11. In downlink, a transmitter may be part of the BS 11 and a receiver may be part of the UE 12. In uplink, a transmitter may be part of the UE 12 and a receiver may be part of the BS 11.

[0036] The wireless communication system may be any one of a multiple-input multiple-output (MIMO) system, a multiple-input single-output (MISO) system, a single-input single-output (SISO) system, and a single-input multiple-output (SIMO) system. The MIMO system uses a plurality of transmission antennas and a plurality of reception antennas. The MISO system uses a plurality of transmission antennas and a single reception antenna. The SISO system uses a single transmission antenna and a single reception

antenna. The SIMO system uses a single transmission antenna and a plurality of reception antennas.

[0037] Hereinafter, a transmission antenna refers to a physical or logical antenna used for transmitting a signal or a stream, and a reception antenna refers to a physical or logical antenna used for receiving a signal or a stream.

[0038] FIG. 2 shows the structure of a radio frame in 3GPP LTE. It may be referred to Paragraph 5 of “Technical Specification Group Radio Access Network; Evolved Universal Terrestrial Radio Access (E-UTRA); Physical channels and modulation (Release 8)” to 3GPP (3rd generation partnership project) TS 36.211 V8.2.0 (2008-03).

[0039] Referring to FIG. 2, the radio frame includes 10 subframes, and one subframe includes two slots. The slots in the radio frame are numbered by #0 to #19. A time taken for transmitting one subframe is called a transmission time interval (TTI). The TTI may be a scheduling unit for a data transmission. For example, a radio frame may have a length of 10 ms, a subframe may have a length of 1 ms, and a slot may have a length of 0.5 ms.

[0040] One slot includes a plurality of OFDM (Orthogonal Frequency Division Multiplexing) symbols in a time domain and a plurality of subcarriers in a frequency domain. Since 3GPP LTE uses OFDMA in downlink, the OFDM symbols are used to express a symbol period. The OFDM symbols may be called by other names depending on a multiple-access scheme. For example, when SC-FDMA is in use as an uplink multi-access scheme, the OFDM symbols may be called SC-FDMA symbols. A resource block (RB), a resource allocation unit, includes a plurality of continuous subcarriers in a slot. The structure of the radio frame is merely an example. Namely, the number of subframes included in a radio frame, the number of slots included in a subframe, or the number of OFDM symbols included in a slot may vary.

[0041] 3GPP LTE defines that one slot includes seven OFDM symbols in a normal cyclic prefix (CP) and one slot includes six OFDM symbols in an extended CP.

[0042] FIG. 3 shows an example of a resource grid of a single downlink slot.

[0043] A downlink slot includes a plurality of OFDM symbols in the time domain and NRB number of resource blocks (RBs) in the frequency domain. The NRB number of resource blocks included in the downlink slot is dependent upon a downlink transmission bandwidth set in a cell. For example, in an LTE system, NRB may be any one of 60 to 110. One resource block includes a plurality of subcarriers in the frequency domain. An uplink slot may have the same structure as that of the downlink slot.

[0044] Each element on the resource grid is called a resource element. The resource elements on the resource grid can be discriminated by a pair of indexes (k,l) in the slot. Here, k (k=0, . . . , NRB×12-1) is a subcarrier index in the frequency domain, and l is an OFDM symbol index in the time domain.

[0045] Here, it is illustrated that one resource block includes 7×12 resource elements made up of seven OFDM symbols in the time domain and twelve subcarriers in the frequency domain, but the number of OFDM symbols and the number of subcarriers in the resource block are not limited thereto. The number of OFDM symbols and the number of subcarriers may vary depending on the length of a cyclic prefix (CP), frequency spacing, and the like. For example, in case of a normal CP, the number of OFDM